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A SPINAL OSTEOSYNTHESIS SYSTEM

The present invention relates to spinal osteosynthesis systems, which find a particularly advantageous application in holding two optionally- consecutive vertebrae relative to each other, with the aim of carrying out spinal arthrodesis, for example, in a human being in order to suppress, for example, the source of pain generated by a fractured vertebra or in order to avoid the risk of paralysis complications arising from the fracture.

Surgeons working in the field of spinal surgery make use in particular of systems that consist essentially of a plate in which an orifice and a slot are formed, and of screws each having a shank with a bone thread terminated by a shoulder head, such screws being suitable for cooperating with the plate so that plate bearing against the vertebrae is held captive between the vertebrae and the shoulder heads of the screws.

Those spinal osteosynthesis systems present drawbacks, in particular because the spinal processes make it difficult to place bone-thread screws in the orifices in the plate so they can be screwed into the vertebral bodies, and do not allow for easy adjustment of the distance between the two segments of vertebrae by the surgeon in order to eliminate the source of pain and bring the segment of the spinal column back to its normal height.

In an attempt to overcome those drawbacks, systems have been developed comprising pedicular screws, lugs, first means for fastening a first end of each lug onto the head of a pedicular screw, at least one plate, and second means for fastening the plate onto the other end of each lug. Nevertheless, those systems are still relatively complex in terms both of putting them in place and of achieving good adjustment to the various distances.

The present invention therefore aims to provide a spinal osteosynthesis system that enables the above-mentioned drawbacks of the prior art to be mitigated to a large extent.

More precisely, the present invention provides a spinal osteosynthesis system comprising at least one pedicular screw with a head, a lug, first means for

fastening a first end of the lug to the head of the pedicular screw, a plate, and second means for fastening the plate to the second end of the lug, characterized by the fact that first means for fastening the first end of the lug onto the pedicular screw head comprise:

- a first portion of hemispherical shape secured to the head of the pedicular screw;

- a second portion of hemispherical shape secured to the first end of the lug, this second hemispherical portion being complementary to the first hemispherical portion; and

- fastener means for fastening together the first and second hemispherical portions when they cooperate one in the other with a common first center of curvature, and

by the fact that the second fastener means for fastening the plate on the second end of the lug comprise:

- a third portion of hemispherical shape secured to the plate,

- a fourth portion of hemispherical shape secured to the second end of the lug, this fourth hemispherical portion being complementary to the third hemispherical portion, and

- fastener means for fastening together the third and fourth hemispherical portions when they cooperate one in the other with a common second center of curvature.

Other features and advantages of the invention appear from the following description of the accompanying drawings given by way of non-limiting illustration, in which:

- Figure 1 is a cross section of a portion of an embodiment of the spinal osteosynthesis system of the invention, this section being in the plane referenced P in Figure 2; and

- Figure 2 is a perspective view of an embodiment of the spinal osteosynthesis system in compliance with Figure 1.

It is specified that, in the figures, the same references refer to the same elements, in whichever figure they appear and however the elements are shown. Likewise, in any of the figures, if elements do not have specific references, their references can easily be found by referring to another figure.

The Applicant also wishes to make it clear that the figures show only one embodiment of the invention, and that other embodiments can also exist which satisfy the definition of the invention.

Moreover, the Applicant makes it clear that when, according to the definition of the invention, the subject matter of the invention comprises "at least one" element with a given function, the embodiment described may comprise a plurality of such elements.

In addition, the Applicant makes it clear that if the embodiment of the invention as illustrated comprises a plurality of elements of identical function and if, in the description, it is not specified that the invention must necessarily comprise some specific number of such elements, then the invention may be defined as comprising "at least one" such element.

With reference to Figure 1, the spinal osteosynthesis system comprises at least one pedicular screw 1 with a head 5, a lug 2, first means 10 for fastening the first end 4 of the lug 2 to the head 5 of the pedicular screw, a plate 6, and second means 20 for fastening the plate 6 to the second end 7 of the lug 2.

According to a characteristic of the invention, the first means 10 for fastening the first end 4 of the lug 2 to the head 5 of the pedicular screw comprise a first portion 11 of hemispherical shape secured to the head 5 of the pedicular screw 1, a second portion 12 of hemispherical shape secured to the first end 4 of the lug 2, this second hemispherical portion 12 being complementary to the first hemispherical portion 11, and fastener means 13 for fastening together the first and second hemispherical portions 11, 12, when they cooperate one in the other with a common first center of curvature 14.

With reference to the second means 20 for fastening the plate 6 onto the second end 7 of the lug 2, they comprise a third portion 23 of hemispherical shape secured to the plate 6, a fourth portion 24 of hemispherical shape secured to the second end 7 of the lug 2, this fourth hemispherical portion 24 being complementary to the third hemispherical portion 23, and fastener means 25 for fastening together the third and fourth hemispherical portions 23, 24, when they cooperate one in the other with a common second center of curvature 26.

In a particularly advantageous embodiment, the fastener means 13 and/or 25 defined above include a fastening screw 30 made up of a threaded shank 31

and a screwing head 32, and means for assembling said fastening screw 30 in cooperation with the two hemispherical portions 11-12 and/or 23-24 so that it sandwiches one of the two portions between the other portion and the screwing head 32.

Preferably, the means for assembling the fastening screw 30, in cooperation with the two hemispherical portions for sandwiching one of the two portions between the other portion and the screwing head, are constituted, like the means 13 shown on the right hand side of Figure 1, by the fact that the threaded shank 31 is secured to the hemispherical portion sandwiching the other hemispherical portion and goes through said other hemispherical portion via a hole 40 of section greater than that of the said threaded shank 31, the screwing head 32 then being screwed onto the threaded shank 31, the two faces 41, 42 of the screwing head 32 and of the hemispherical portion that come into contact with each other being of complementary hemispherical shapes and with centers of curvature that coincide substantially with the center of curvature 14 of the hemispherical portions cooperating one in the other.

Advantageously, when the first and second hemispherical portions 11, 12 are respectively convex and concave, the two faces 41, 42 of the screwing head 32 and of the hemispherical portion that come into contact with each other are respectively concave and convex, as shown on the right hand side of Figure 1.

Nevertheless, in another embodiment, the means for assembling the fastening screw 30 in cooperation with the two hemispherical portions for sandwiching one of the two portions between the other portion and the screwing head 32 are constituted, like the means 13 shown on the left hand side of Figure 1, by the fact that the threaded shank 31 is screwed into the hemispherical portion sandwiching the other portion and goes through the other portion via a hole 40 of section greater than that of the threaded shank 31, the screwing head 32 being secured to the threaded shank 31, the two faces 41, 42 of the screwing head 32 and of the hemispherical portion that come into contact with each other being of complementary hemispherical shapes and with centers of curvature that coincide substantially with the center of curvature 26 of the hemispherical portions cooperating one in the other.

Advantageously, when the third and fourth hemispherical portions 23, 24 are respectively convex and concave, the two faces 41, 42 of the screwing head 32 and of the hemispherical portion that come into contact with each other are convex and concave respectively, as shown on the left hand side of Figure 1.

In terms of its essential definition, the above-described embodiment of the spinal osteosynthesis system of the invention comprises at least one pedicular screw 1, one lug 2 per pedicular screw, and at least one plate 6. Nevertheless, in practice, it is clear that such a system will be made in the manner shown in Figure 2, for example.

In the embodiment of Figure 2, the system comprises a plurality of pedicular screws 1, there being three of them in Figure 2, one lug per pedicular screw, and one plate 6, which plate 6 includes at least as many third hemispherical portions 23 as there are lugs 2, and hence as there are pedicular screws.

Nevertheless, in other possible embodiments, the system may include a plurality of lugs per pedicular screw, the first ends of the lugs being superposed one on another, so that they can turn relative to one another.

In order to implant a spinal osteosynthesis system such as that shown in Figure 2, the surgeon begins by screwing the three pedicular screws 1 into the vertebral pedicles. In view of the difficulty of implanting such screws, it is impossible to ensure that they are accurately parallel to one another and that the heads are in perfect alignment along the same straight line. Under such conditions, it is practically impossible to place a plate on the three screw heads, since the plate is generally rectilinear.

With the spinal osteosynthesis system of the invention, once the pedicular screws have been screwed firmly into the pedicles, the surgeon places one lug 2 on each pedicular screw in such a way that the first and second hemispherical portions 11, 12 are superposed as shown in Figures 1 and 2, the threaded shank 31 going through the hole 40 and the screwing head 32 being screwed on loosely.

The surgeon then assembles the plate 6 to cooperate with the second ends 7 of the lugs 2 so that the third and fourth hemispherical portions 23, 24 cooperate one in the other and then screws the threaded shanks 31 loosely into the lugs 2 (left hand side of Figure 1).

Using a well-known ancillary instrument, the surgeon distracts the vertebrae so that they take up their desired relative position. While the vertebrae are moving relative to one another, the lugs 2 and the plate 6 also move relative to one another and, because of the hemispherical portions 11-12, 23-24, they are always in the desire optimum position.

The surgeon then locks the hemispherical portions by means of fastening screws 30 and can remove the distraction ancillary.

With the spinal osteosynthesis system of the based on the invention having structural characteristics as described above, it is thus very easy to position the plate 6 relative to the pedicular screws 1, given that each lug 2, can move within a cone around the head 5 of the pedicular screw with which it is associated, and that the plate 6, can move within a cone around the second end 7 of the lug 2.

The description above shows the main advantages of the spinal osteosynthesis system of the invention. Namely: the pedicular screws 1 can be implanted relatively independently of one another, the plate 6 can always be connected to the pedicular screws whatever their relative positions and, since it is positioned laterally relative to the pedicular screws, it can be put in place without being obstructed by spinous processes.